SCIENCE.

FRIDAY, MARCH 1, 1895.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison on Hudson, N. Y.
Subscriptions (five dollars annually) and advertisements should be sent to the Publisher of SCIENCE, 41 East 49th St., New York, or Lancaster, Pa.

*ON DR. WILLIAM TOWNSEND PORTER'S INVESTIGATION OF THE GROWTH OF THE SCHOOL CHILDREN OF ST. LOUIS.**

DR. Porter's investigations on the growth of the school children of St. Louis claim particular attention, as the author opens a number of new problems and proposes new methods of inquiry. His conclusions are far-reaching and have a close relation to the method of treatment of a number of questions. It is the importance of these investigations, which are based on very extensive material, which induces me to subject the author's methods to an examination.

Dr. Porter's scheme of measurements is based largely upon that used by Dr. H. P. Bowditch in his investigations in Boston, and on the one which I used in the collection of data in Worcester, Mass. To these the measurements of girth of chest and of strength of grasp are added. It must be regretted that Dr. Porter determined the age of the child at its nearest birthday,

*1. The Physical Basis of Precocity and Dullness. (Transactions of the Academy of Science of St. Louis, Vol. VI., No. 7, March 23, 1893.)

2. The Relation between the Growth of Children and their Deviation from the Physical Type of their Sex and Age. (Ibid., Vol. VI., No. 10, November 14, 1893.)

3. Untersuchungen der Schulkinder in Bezug auf die physischen Grundlagen ihrer geistigen Entwicklung. (Verh. d. Berliner Gesellschaft für anthropologie, 1893, pp. 337-354.)

4. The Growth of St. Louis Children. (Transactions of the Academy of Science of St. Louis, Vol. VI., No. 12, April 14, 1894, pp. 263-380; republished in Quarterly Publications of the American Statistical Association, N. S., No. 24, Vol. III., December, 1893, pp. 577-587.)

5. The Growth of St. Louis Children. (Ibid., Nos. 25, 26, Vol. IV., March-June, 1894, pp. 28-34.)

while heretofore all investigators determined the age in full years. There exists, therefore, a difference of half a year between the period of Dr. Porter's tables and all others which makes a comparison difficult.

Dr. Porter bases all his discussions on the assumption that all series of observations of children of any given age are probability curves, and he illustrates this point by a detailed discussion of the observations on stature of eight-year-old girls. In connection with this subject he discusses the meaning of the probable deviation, of the mean, and of the average value of the series. Although he employs both the mean and average values, he evidently inclines toward the use of the former. I will not dwell at length upon the fact that whenever the curve is really a probability curve the average is a better value than the mean, because it is more accurate, nor on the other fact that the mean deviation gives a more constant value than the probable deviation, and is therefore the better value, as both considerations have little practical bearing, although I consider them of importance from a theoretical point of view.

It may be granted for a moment that the curves are probability curves. Then there remain two objections to Dr. Porter's values. The one is that the difference in numbers of individuals observed for each year is not taken into consideration. This difference in numbers has the effect that the average age of all individuals whose nearest age is six years will be a little more than six years. These corrections amount to more than 3% of the annual growth, during the first and last years to even more. It affects the annual rate of growth of stature to the amount of several millimeters, the weight to the amount of half a pound.

Furthermore, Dr. Porter makes a linear interpolation for determining the mean, while the general curve ought to be taken into consideration. The determination of the 50% point of a series ought to be based on the values found at two points, at least, on each side. The same may be said of the interpolation for all the other percentile grades. The corrections made necessary by these two causes are not great, but sufficient to make all the millimeters and tenths of kilograms inaccurate.

A more important objection is based on the fact that the observed curves are *not* probability curves. In examining Dr. Porter's curve for stature of girls of 8 years of age (paper No. 4, p. 286), it will be seen that in the first part of the table the differences between theory and observation are all positive, while in the second part they are, with one exception, all negative. When the curves of stature, weight, span of arms, height sitting, girth of chest for girls from 12 to 15 years of age, and for boys from 14 to 18 years of age are consulted it will appear that the asymmetry is still more marked. Dr. Porter himself quotes at length Dr. Bowditch's remarks on this asymmetry (Ibid., p. 298), and calls attention to the difference between mean and average. These constantly occurring differences and their regular distribution are the very best proof that the curves under consideration are not probability curves. If this is the case, neither the average, nor the mean, nor the most frequent value represent the type of the age to which the curve refers. This can be determined only by a detailed examination of the causes of the asymmetries.

I have stated at a former time (SCIENCE, Vol. XIX., May 6, May 20, 1892) what I believe to be the cause of this asymmetry, and I will revert to this subject after the discussion of one of Dr. Porter's most fundamental deductions.

He concludes, from his data, that the basis of dullness is deficient physical development; that the basis of precocity is an unusually favorable physical development.

His method has been to compare the measurements of all children of a certain age attending various grades of schools. He found that those in the lower grades were inferior in their measurements to those attending the higher grades. He expresses this result in the following language (No. 1, p. 168): "Precocious children are heavier, and dull children lighter, than the mean child of the same age. This establishes a basis of precocity and dullness." I believe that the method of investigating this point is not free of objections. It would, indeed, be a serious accusation against the teachers of St. Louis if they should entirely disregard the effects of physical development in grading their pupils. However crudely this may be done, it is certainly done to a limited extent. Sickly children who stay out of school for a great portion of the term will lag behind; vigorous ones will advance more rapidly. Be this the case or not, the fact remains that children who are physically more vigorous accomplish a greater amount of mental work. But I do not believe that Dr. Porter's wording of the phenomenon conveys the correct interpretation. I should prefer to call the less favorably developed grade of children retarded, not dull; and these terms are by no means equivalent, as a retarded child may develop and become quite bright. In fact, an investigation which I had carried on in Toronto with the same object in view, but according to a different method, gives just the reverse result. The data were compiled by Dr. G. M. West, who found that the children pronounced by the teacher as bright were less favorably developed than those called dull by their teachers. Furthermore, I do not believe it is correct to say that the facts found by Dr. Porter establish a basis of precocity and dullness, but only that precocious children are at the same time better developed physically; that is to say, the interesting facts presented by Dr. Porter prove only that children of the same age who are found in higher grades are more advanced in their general development than those who are found in lower grades. Dr. Porter has shown that mental and physical growth are correlated, or depend upon common causes; not that mental development depends upon physical growth.

This brings me back to the question of the cause of the asymmetries of the observed curves. According to the above interpretation of Dr. Porter's results (which is merely a statement of the observed facts), we must expect to find children of a certain age to be on different stages of development. Some will stand on the point corresponding exactly to the age, while others deviate from it. This was the assumption which I made in the paper quoted above, when trying to explain the asymmetries of the curves, and I consider Dr. Porter's observations a very strong argument in favor of my theory, which is briefly as follows:

When we consider children of a certain age we may say that they will not all be on the same stage of development. Some will have reached a point just corresponding to their age, while others will be a little behind, and still others in advance of their age. Consequently the values of their measurements will not exactly correspond to those of their age. We may assume that the difference between their stage of development and that belonging to their exact age is due to accidental causes, so that just as many will be less developed as further developed than the average child of a particular age. Or, there will be as many children on a stage of development corresponding to that of their age plus a certain length of time as corresponding to that of their age minus a certain length of time.

The number of children who have a certain amount of deviation in time may be assumed to be arranged in a probability curve, so that the average of all the chil-

dren will be exactly on the stage of development belonging to their age.

At a period when the rate of growth is decreasing rapidly, those children whose growth is retarded will be further remote from the value belonging to their age than those whose growth is accelerated. As the number of children above and below the average of development are equal, those with retarded growth will have a greater influence upon the average measurement than those whose growth is accelerated, therefore the average value of the measurement of all the children of a certain age will be lower than the typical value, when the rate of growth is decreasing; higher than the typical value when the rate of growth is increasing. This shows that the averages and means of such curves have no meaning as types. I have shown in the place quoted above, how the typical values can be computed, and also that for stature they differ from the average up to the amount of 17 mm.

These considerations also show clearly that the curves must be asymmetrical. Supposing we consider the weights of girls of thirteen years of age, the individuals composing this group will consist of the following elements: girls on their normal stage whose weight is that of the group considered, advanced girls, and retarded girls. In each of these groups which are represented in the total group in varying numbers, the weights of the individuals are probably distributed according to the laws of chance, or according to the distribution of weights in the adult population. What, however, will be the general distribution? As the rate of increase of weight is decreasing, there will be crowding in those parts of the curves which represent the girls in an advanced stage of development, and this must cause an asymmetry of the resultant general curve, which will depend upon the composition of the series. This asymmetry does actually exist at the period when the theory demands it, and this coincidence of theory and observation is the best argument in favor of the opinion that advance and retardation of development are general and do not refer to any single measurement.

Futhermore, the increase in variability until the time when growth begins to decrease, and its subsequent decrease, are entirely in accord with this theory. I have given a mathematical proof of this phenomenon in the paper quoted above (SCIENCE, May, 1892). Dr. Porter has called attention to the same phenomenon in his paper of November, 1893, but I believe his formulation is not sufficiently general, nor does he give an interpretation of the phenomenon which may be explained as follows: The probability of a child not being in the stage of development corresponding to its age follows the laws of chance. With increasing age the mean deviation from the normal type must increase. Assuming that at the age of four years, .5 year represents the mean deviation, then a certain number of children will be in the stage of development corresponding to 3.5 and 4.5 years. At the age of sixteen years the mean deviation will probably be one year, and just as many children would be on the stages of fifteen and seventeen years as there were of the four-year old children on the stages of 3.5 and 4.5 years. The absolute amount of growth (in girls) from fifteen to seventeen years is less than from 3.5 to 4.5, so that for this reason a decrease in variability must be found at the time when the rate of growth begins to decrease. On the other hand, the difference between individuals which will finally become tall or short, increases with the increase of growth, so that the combined effect of these counteracting causes will be a maximum of variability at the period preceding puberty. Dr. Porter's formulation of the phenomenon (No. 2, p.

247) that "the physiological difference between the individual children in an anthropometric series and the physical type of the series is directly related to the quickness of growth" does not quite cover the phenomenon.

It will be seen from these arguments that the very natural supposition that some children develop more slowly than others is in accord with all the observed facts. It was necessary to prove this in some detail, because the further interpretations made by Dr. Porter largely hinge upon this point.

These conclusions are based on the assumption that "the type at a certain deviation from the mean of an age will show the same degree of deviation from the mean at any subsequent age; for example, a type boy in the 75 percentile grade at age 6 will throughout his growth be heavier than 75 per cent. of boys of his own age." (No. 4. p. 293.) This assumption which I have criticised on a former occasion (SCIENCE, Dec. 23, 1892, p. 351), is most decidedly incorrect, and with it fall all the conclusions in regard to the growth of tall children and short children.

We know a number of facts which show plainly that the assumption is incorrect. It has been shown in Dr. Bowditch's tables that Irish children are shorter than American children. If the position of the American child is expressed in percentile grades of the whole Boston series, and that of the Irish child in the same manner, it will be seen at once that they diverge more and more with increasing age. Pagliani's measurements of Italian children and my own of Indian tribes of different statures bring out the same point still more strongly.

I think the error underlying the assumption that the average children retain their percentile rank can be shown best in the following manner: We know by means of observations the distribution of measurements for certain ages. If the assumption is made that the same children remain on the average in the same percentile grade a certain very complex law of growth follows. We may invert this reasoning by saying: Only if the assumption of a certain very complex law of growth is made can the same children remain in the same percentile grade. For any different law of growth they would change from one grade to another. There is no inherent probability in this law; on the contrary, it was quite unexpected and surprising when first promulgated. As a matter of fact, three factors condition the rate of growth: hereditary influences, the preceding life history of the individual and the average conditions during the period under consideration, and it is quite unlikely that these factors should always be found to stand in such a relation as to result in general stability of percentile grades.

As the facts disprove this assumption, and as the cause of the asymmetries remains entirely obscure under it, while they can be fully explained in all their details by the theory advanced before, I cannot acknowledge that the conclusions reached regarding the growth of tall and short children are correct.

On pp. 339–348 of his fourth paper Dr. Porter makes a valuable suggestion regarding the practical application of measurements to the determination of the stage of development of individuals. His proposal is to compute the distribution of weight, chest, girth and others correlated to various heights. Then all children are under the suspicion of being abnormally developed who differ much from the standard values. Dr. Porter assumes the narrow limits of the probable deviation as the limits of normal variability. It may be a question where these limits ought to be drawn, but there can be no doubt that this method is much better than the one applied in our gymnasia, namely, that the individual is expected to

be in all his measurements on the same percentile grade. This latter method is based on a quite erroneous theory of the proportions of the body. Dr. Porter's method is also better than that based on single measurements, as it points out abnormal proportions, not simply abnormal size. It is necessary, however, to bear in mind the one restriction that many measurements are not closely correlated with stature, but have different correlations. This is the case with girth of chest, strength of squeeze and many others. Therefore their correlation to stature will not give more satisfactory results than the study of the single measurements alone. It will certainly be of great use to school hygiene to subject all children whose proportions are abnormal to a medical examination, but it will not be possible to determine by means of the measurements what individuals are retarded in growth and what are advanced, as Dr. Porter suggests, except in very exceptional cases. The correlation between any two measurements is so slight that a great many cases which are normal for one year are also quite normal for the preceding and following years at least. This is also shown by the fact which is apparently so contradictory, that children of a certain height are the heavier the older they are (according to Bowditch), but that also children of a certain weight are the taller the older they are.

Finally, I must say a word in regard to Dr. Porter's objection to the combination of measurements taken in different cities. It is, of course, true that the results in various cities depend upon the composition of the population and its geographical and social surroundings. If we knew all these factors and their influences it would be necessary to sub-divide the series of each city into numerous divisions. As we do not know the exact influence of these factors, we must endeavor to take as our basis a general curve, including as many individuals as possible of the same population but under a diversity of conditions and compare the curves determined by certain factors with them. It is, therefore, perfectly correct to compute the growth of American children from data collected in various cities, provided each city is given its proper weight according to the number of children measured. The more cities and villages are included in such a combination, the more nearly we shall get the curve representing the growth of the American child. By comparing the general curve with the ones obtained in different cities we can investigate the causes which produce the difference between the individual curves and the general curve. We know that nationality, occupation, social status have a considerable influence. I have found that first-born children exceed later-born children in size. The effect of all these causes can be studied by comparing the individuals representing each group of factors with the general population.

FRANZ BOAS.

NEW YORK.

---

*LABORATORY TEACHING OF LARGE CLASSES IN BOTANY.**

THE great increase in the size of the classes in Elementary Botany during late years in Harvard College has forced their teachers to the development of some system for their efficient and economical management in the Laboratory. Under the guidance of Professor Goodale there has been worked out the plan upon which are based the recommendations made in this paper; indeed, what I have to say is little more than a description of the system in use there during the last year I was connected with it, *i. e.*, 1892–'93. My observations are, therefore, based not upon theory alone, but upon the results of trial and selection.

*Read before the American Society of Naturalists, Baltimore, Dec. 28, 1894.

The conditions which had to be faced were these: A class, numbering towards, and in one year over, 200 men, and likely in the future further to increase, composed of beginners ignorant of how to study *things*, comes in for a course in General Botany, extending from the middle of February to the first of June, in all some fifteen weeks. There are two regular weekly lectures. The Laboratory work cannot for academical reasons exceed an average of four hours per week, and for practical reasons it must be confined to the hours 11–1 and 2–5 Tuesday, the same hours on Thursday, and 9–1 Saturday, *i. e.*, only 14 hours in the week are available. The normal seating capacity of the Laboratory is 75, but the supply of dissecting microscopes and boxes for students' utensils, books, etc., is enough for over three-fourths of the class.

I give thus fully a statement of the conditions at Harvard, because they illustrate in kind, though perhaps in unusually favorable degree, the difficulties which in more or less modified form must be faced in all large colleges providing elementary laboratory instruction, and to which an efficient system of laboratory management must be adapted. These conditions may be classified for purposes of discussion as follows:

1. The classes are too large for individual teaching by the instructor.
2. Laboratory hours must be adjusted to other academic work, to insufficient accommodations and sometimes to yet other considerations.
3. Many students of diverse attainments must be taught how to work and to think scientifically, and must be kept progressing together through the stages of a logically-graded course.
4. Large quantities of special material must be provided at an unfavorable season.

I have placed first what all admit to be the greatest drawback to large laboratory classes, but one which seems inseparable from our unwieldy colleges, *i. e.*, the impossibility of individual knowledge of and contact with his students by the instructor. That this kind of teaching, this diagnosis of each case and fitting of proper treatment to it, is the only good kind, and that no development of methods or systems, or of leadership of the whole class by one man, can replace it, is pedagogically so axiomatic that the instructor should here take his stand squarely and insist that his students shall have it, if not from him directly, then from competent assistants trained by him. I regard this as the first great essential in the laboratory teaching of large classes—competent assistants.

The source of supply of such assistants is not far to seek; they should come from amongst the advanced students who have been through the course and who intend to make teaching a profession. Any college with elementary courses large enough to need such a system as we are discussing must have advanced students in proportional numbers, and skillful management of the real advantages of the position should give the instructor his choice from among them. In Harvard College the supply has always exceeded the demand; the prestige, experience and money attaching to the positions make them attractive to the best men.

The assistants having been thus selected, it is essential to place each in full charge of a section which he keeps without change to the end of the term, in order that he may come to know well and teach well each individual. These sections should never exceed thirty men, and twenty-five is a much better, and twenty the best number. The instructor himself will, of course, visit the laboratory constantly, but he will do far better to go about among the men generally than to take a section himself. Moreover, great freedom should be allowed to the judgment of each assistant in the details of his

teaching. There must be, to be sure, a uniform plan of study for the course, but the carrying-out of the plan in details should be left to the assistant, who should be held responsible for his results rather than his methods. It is very desirable, or perhaps, I should say, necessary, to hold weekly meetings of the assistants at which the coming laboratory topics are discussed, uniform ways of treating difficult or morphologically debatable questions agreed upon, and pedagogic advice given, the latter, as I have found, always eagerly received and acted upon. In this way, in conjunction with the weekly guides to be mentioned below, all desirable uniformity of treatment can be secured.

It is necessary, and indeed, good policy as well, to pay the assistants; the amount will vary according to the general scale of expenditure in vogue in the particular college. One dollar an hour may be considered fair, perhaps the maximum that it is needful to pay.

Let us consider secondly how conflicting hours may be adjusted to insufficient accommodations, and to the need of bringing each man always under the same assistant. The solution of this often appalling problem can be found only in this: the instructor must claim for his Laboratory work equal rank with any other college exercises, make the choice of hours, or rather sections, as wide as possible, and require students to work exactly in these sections or else remain out of the course. The size of the sections must be limited partly by the number an assistant can manage, partly by the seating accommodation of the laboratory. Thus a room of fifty to sixty seats can accommodate two sections at once. The hours should be arranged so as to give at least two hours of consecutive time; the best arrangement for a four-hour-a-week course is to have each section meet in two-hour periods at the same hours on two different days. Thus a section meeting 11–1 Tuesday would meet 11–1 Thursday. No student should be allowed to break hours and come in different sections if it can possibly be avoided. To arrange the students in sections, each should be asked to hand in, at the opening of the work, his preference and his second choice. The great majority can be assigned to their preference, only a few, selectable by lot, need to be placed in their second choice in order to adjust the sizes of the sections. In order to prevent all confusion, we have found it very useful to give each student a card stating the number of his section, of his seat, of his microscope, of his box and the name of the assistant, and to check off for each section on blue-print plans of the laboratory and lists of instruments, etc., the numbers as assigned. By this plan successive sections may use the same seats and instruments without confusion and each come always under its own assistant.

We have next to notice how the labor and confusion of getting the sections to work may be minimized and the time of the assistants economized for the higher grades of their teaching work, and how the sections may be kept progressing uniformly. The beginner (and for that matter the most advanced of students), when a new topic is placed before him, has no idea of what he is to study about it, of what is important and what is not, of the nomenclature he is to employ. The questions "what am I to do with it?" "what do you want me to do next?" dreadful as they sound, are yet natural enough. If these questions can be answered for each student without reference to the assistant it is an immense gain, and they can be answered by a printed guide or synopsis of the week's work supplied each week to each student. These should be arranged upon the approved plan in use in the many excellent laboratory manuals, *i. e.*, they should indicate the points which it

is needful to study, suggest some idea of their relative importance, give needed bits of information now and then, and in general supply just enough data to allow the student to work by himself to correct conclusions. But an ordinary laboratory manual is not sufficient, for a great value of these weekly guides is that they fit the exact material to be used, the state of advancement of the class, and the logical course laid out by the instructor, which cannot be the same as that of anybody else's manual. These guides may also be made to supply botanical terms, always upon the good pedagogic principle of making the student feel the need of a term before supplying it, and then offering it not as a term with a definition, but as a definition or description which can be expressed in a single word. The effect of these guides upon the order and rapidity of work is remarkably great, and they enable one assistant to teach a much larger section than is possible without them.

It is also of very great value to the laboratory work to have the lectures accompany, and actually, as they do theoretically, supplement it. This is practically possible, though perhaps not always convenient. The most logical course (to be briefly described immediately) that I have been able to develop in my few years' teaching does allow the lectures to keep with and supplement the laboratory work throughout the term. Laboratory study must always be the study of a few type forms ; the correlation of the data thus gained, their bearing upon general principles and their relation to the science as a whole must be the function of the lecture, and this is the better performed when the latter follows as closely as possible upon the former and while it is still fresh in mind. A few minutes at the beginning of each lecture devoted specially to the topics of the laboratory work just past, and its relation to what is to come, has been found to be very profitable.

We come finally to our fourth and last problem, how can good materials be provided in the winter to such large classes? A college which has abundant greenhouses hardly needs to ask this question. What remarkable results may be obtained in providing large quantities of material from small space is shown by Mr. B. M. Watson's work at the Bussey Institution in supplying material to the classes at Harvard. For those less fortunately situated, its solution is to be found in so arranging the course that materials available in the markets or easily grown, come first, and are gradually replaced by out-door materials as the season advances. Happily the most logical plan of treatment for a general course in Botany lends itself exactly to this procedure. Experience has shown that with elementary classes it is desirable to consider plant life as a cycle, which may best be broken for study at the seed. If now the structure and morphology of the seed be the first topic in both Laboratory and Lectures, and its development into the young plant the second, and if then the plant-organs leaf, root, stem, flower and fruit be treated in succession, we are in both brought back to the starting point, the seed. If, moreover, in the lectures, the full biology and physiology of each organ be considered along with its anatomy and morphology and as determining these, then are the topics not only treated in the most logical and instructive fashion, but the lectures and laboratory work may be kept together, the one truly supplementing the other; and the topics are taken up in the order which allows material best obtainable in winter to come first, gradually giving place to that which the spring offers. The seed, always obtainable, comes first, then follow germinating embryos and young plants easy to grow in wardian cases in class rooms or at very small cost in the nearest greenhouse. Leaves may be obtained from the same greenhouse, from

evergreen shrubs out of doors or even bought in the markets, as celery, cabbage, etc. Roots may likewise come from the markets, stems and buds abundantly from the trees out of doors, and towards spring the latter may be forced to open in warm rooms. Far too little use is made of these easily obtained materials. By the time the vegetative organs have been studied the first Apetalæ will be in bloom, and if the students have been properly taught to use eyes and hands the Apetalæ will present no difficulties; later come other wild flowers, and all is easy.

Allow me, in conclusion, to sum up the points of this paper. In the laboratory teaching of large classes, the first essential is a recognition of the fact that nothing can replace individualism in teaching and that a sufficient number of assistants should be employed. These assistants must be intending teachers, given some pedagogic instruction, supplied with a uniform plan of work, but left very free in the details of their modes of reaching the students. Classes should be divided into sections with fixed hours and containing not more than thirty men, over each of which one assistant has entire charge until the end of the term. As an aid to uniformity of plan and to answer the innumerable legitimate questions which arise in laboratory work, as well as to supply technical nomenclature, weekly printed guides, fitted to the exact work being done, should be supplied to each student. Lectures and laboratory work should be kept together and follow such a course that the vegetative organs upon which material is at all times available should be studied in the winter, and the reproductive organs in the spring or summer.

So much for a general plan; each teacher must vary it in adaptation to his own needs. W. F. GANONG.

SMITH COLLEGE.

MAGNETISM AND THE WEATHER.

MUCH time has been devoted to the study of magnetic and meteorologic observations with the hope of establishing a definite connection between the two. The results thus far have been almost entirely negative, although a connection has been found with auroras, and the diurnal range of air pressure is now believed to be a thermo-electric phenomenon, allied to the diurnal range in the swings of the magnetic needle. There are certain well established facts that have been ascertained regarding magnetism that almost always stand at the base of all such investigations, although it is admitted that magnetic phenomena are extremely complex, and those of the weather are far more so.

1. The three principal magnetic conditions or fluctuations are as follows: (a) The diurnal change due to some combined solar and terrestrial action. (b) Magnetic storms, which are peculiar and sharp disturbances, generally originating in the sun. These often occur at three or four successive rotations of the sun.

(c.) A gradual change in magnetism from one day to the next. These are quite singular, and have been studied more than any other conditions in the hope of establishing some relation with our weather.

2. In studies of magnetism strenuous and long continued efforts have been made to establish a regular recurring period depending upon the rotation of the sun. It is easy to see that if there were such regular period its discovery would be of the profoundest significance. The results of such studies, however, have been far from satisfactory. It is known that sunspots have a different period of rotation, according as they are near or far from the equator, and this fact is enough to show the extremely dubious nature of an attempt to fix on any definite period for recurring solar effects. It is not at all surprising that more than a

score of periods have been determined from 25.5 to 27.5 days, depending somewhat upon the data employed and upon the method of its manipulation. It is very certain that, if any one will take the 'horizontal force,' for example, and arrange the observations in intervals of 26 days (the best thus far found) he will quickly find that, judging from the disturbed days, there is absolutely no fixed interval. These disturbed days would seem the very best material for such studies, as they are very definite. These days will occur for three or four rotations most beautifully, but after that the disturbance disappears and no more will appear along that line for a score of rotations.

In the same way one will very quickly find, in using the data and leaving out the disturbed days, that there is absolutely no recurring period of 26 days or any fraction of that interval. Sometimes by grouping ten rotations one will find a fairly good fluctuation, but the very next group of ten rotations will make 'hodge podge' of the previous group. This would seem an extremely important point to settle, as months have been devoted to fruitless efforts in trying to determine such a period.

3. The fluctuations under (c) above are simultaneous over the whole earth, as has been shown by the records at Batavia, India, Los Angeles, Cal.; St. Petersburg and Tiflis, in Russia; Vienna, Austria; Washington, D. C., and Zikawei, China. One is struck at once by the wonderful regularity of these fluctuations over the whole Northern Hemisphere. Making allowance for the difference of time and for disturbed days, the fluctuations are found to be exactly the same at each station, and the record at a single station will answer perfectly for comparison with any supposed related meteorologic phenomenon.

4. After thirteen years of study and careful discussion I am satisfied that the pressure of the air, or perhaps the fluctuations of the dew point, are by far the best to use for determining a possible connection with magnetism. I am also perfectly satisfied that, except in the cases specified above, there is no direct relation between magnetic and meteorologic phenomena, and this is also the outcome of the exhaustive studies in England and on the continent. I am also satisfied that there is an indirect relation, but the phenomena are so extremely complex that it has proven impossible to determine it up to the present.

5. In all studies of this character, and in all attempts at determining coincidences between such phenomena, one will always find a most valuable check by cutting up the long list of rotations into groups of 7, 10 or 14 rotations in each. If these separate groups do not show a thread running through them, or fluctuations common to all and continually recurring, he may be satisfied that there is nothing in it. There is a peculiar and well-nigh unaccountable fascination in arranging and summing groups of figures in the hope that something may come, but continuous effort will show that there is something back of it all which is not understood, and no headway can be made by direct comparisons.

H. A. HAZEN.

FEBRUARY 1, 1895.

SIMILAR INVENTIONS IN AREAS WIDE APART.

As a contribution to the much disputed question of the occurrence of similar inventions in areas wide apart, I desire to call the attention of readers to the device for weaving of which I have found abundant examples in the Pueblo country, in the New England States, and in Finland.

The apparatus consists essentially of a small rectangular frame-work in which are placed a series of perpendicular slats perforated in the middle. It has the appearance

of a grating of small bars about one-sixteenth of an inch apart, and each bar is pierced in the middle. In fact, all of these are the harness of a small loom used in weaving tape, braid, garters, belts and the like.

Among the old-time families of New England, this apparatus is set up by taking a ball of twine or thread which is to constitute the warp, and walking around a number of chairs placed at a distance from one another as many times as there are to be threads in the warp. This coil is then cut apart, one end tied together in a knot, and the separate threads of the other end passed through the holes of the slats and between them. This apparatus is worked by lifting and depressing this frame as the weft shuttle is passed backward and forward by the hand. At each turn the weft is beaten home by the harness, the lower end of which is held between the knees, by the shuttle, or by the hand.

In a Zuñi example in the Museum set up by Mr. Cushing, the weaver sits upon the ground, having the far end of the warp fastened to some part of the building, and the proximal end attached to a stick forming part of a belt. The very same process employed by the New England woman is also in vogue among the Pueblos. By lifting and depressing the frame which is simply a couple of parallel sticks to which split reeds are tied, having holes burnt through the center, the weaver is able to pass the shuttle stick backward and forward.

When the Pueblo woman wishes to make short garters she uses the soles of her feet as a resting place for the little bar to which the far end of the weft is attached. Her shuttle is a stick on which the weft yarn is wound.

The Finnish harness is carved from a single block of wood, the upper and lower borders being somewhat cylindrical and the upright bars carved like little slats from the solid piece. These are perforated exactly after the manner of the New England examples.

I learn by inquiring at the Patent Office in Washington, that in Belgium a patent has recently been issued for an improvement on this style of weaving apparatus.

I leave the question open as to the amount of contact between the Fins, the New England housewife and the Pueblo woman. It is easy enough to account for the dispersion of this apparatus among the white people of Europe, and thence among the Fins and the New England farmers. The only question for us to inquire into now, is, where did the Pueblo woman learn to weave after this fashion?

Dr. Matthews tells me that the Navajo do not use this frame, but make their belts by means of a harness similar to that which they employ in making their blankets. It is also a question where and how the Navajos learned to set up a loom so much like those found among the primitive European weavers. It is a fact that the Aino employ precisely the same apparatus as do the Navajo.

O. T. Mason.

Washington.

THE SOCIAL SENSE.

All persons thrown intimately with children from about four years of age and later may serve psychologists by making detailed observations of what may be called '*chumming*' on the part of children and youth. By 'chumming' is meant all instances of unusually close companionship voluntarily made, 'platonic affection,' personal influence one over another when this influence is limited more or less to one person, and when the relationship is stronger than ordinary and is shown in any unusual or remarkable ways, such as bearing punishment for or with the other, moping or becoming very unsocial when separated. Cases of

boys chumming with boys, and girls with girls, are especially valuable; and of older persons of the same sex. Similar observations are needed on cases of marked or unreasonable *antipathy* of one child to another.

The object of the inquiry is to get light on the growth of the child's social sense, what it is that attracts and repels him most in others. To this end observations on the following points are especially desired by the writer.

In every case of chumming or antipathy:

1. (a) Ask the child A why he loves or dislikes the child B. Take down the answers in full. (b) Repeat the question once a week for six weeks at least, if the phenomenon continues.

2. (a) Observe what A imitates most in B, and (b) whether he imitates the same actions or qualities in others besides B. (c) Note whether what A imitates in B is more prominent in B than in other persons.

3. (a) Observe how far A shares his toys, property, food, pleasures, etc., with B more than with other children. (b) Ask him why he gives his things to B. (c) Observe whether this keeps up if B does not reciprocate.

4. (a) Observe any cases in which A is willing to suffer for or with B. (b) Whether he will fight for him, or defend him with words (give details of actions or words of defense).

5. Observe whether B figures largely in A's dreams (a) by noting any speech aloud when sleeping, and (b) by asking A frequently what he dreamed about the preceding night (being careful not to suggest B to him in any way).

6. State all the details of the relation between A and B especially. (a) Do they see each other oftener than they do others? (b) Do they sit together in school? (c) Do they room or sleep together? (d) Have they any common infirmity or fault (stammering, defective vision, stooping, deceitfulness, &c.)? (e) Have they ever been punished or disgraced together in school or at home?

7. Give (a) what is *known* (not mere impressions) of the disposition of each; (b) the length of time they have shown the liking or antipathy.

8. In case of the breaking off of the liking or antipathy (a) note all the facts which lead to it. (b) Question each child as to why he has ceased to like or dislike the other.

9. When the relation is mutual make the same series of observations with the second child, B, as with the first, A (as given above).

10. Give the number of companions of each child reported on: (a) Number of brothers and sisters, and their ages and places of residence with or away from the child reported on. (b) Amount of time per day which the child spends with other children in school and on the street, etc.

11. Make special note of any unusual occurrences or action, showing the affection or antipathy, which are not covered by this schedule.

N. B. All observations should cover as many of these enquiries as possible, yet observations of some of them only should still be sent in. All observations should be carefully arranged under the headings of the schedule, *i. e.*, by the numbers, letters, etc., in order to secure correct classification. All reports and enquiries should be addressed to the undersigned at Princeton, N. J., and should bear the name and address of the sender plainly written. All names, personal details, etc., are strictly confidential, except when special consent to the contrary is given in further correspondence.

J. MARK BALDWIN.

PRINCETON.

AMERICAN STUDENTS AT THE NAPLES ZOÖLOGICAL STATION.

In another number of Science the steps leading to the establishment in 1892 of the United States Table at Naples, by the Smithsonian Institution are described. Upon behalf of Harvard College, Prof. Alexander Agassiz subscribed for a second table at the same time. Mr. Willian E. Dodge, of New York, has recently visited the Station, and has offered to contribute $250 a year for three years toward a third American Table. In response to this offer Dr. Anton Dohrn has sent to Mr. Dodge the following interesting letter, giving a complete history of American work at the Naples Station up to the present time:

"When I established the Station I had a correspondence with Professor Louis Agassiz, who greatly applauded my plans, but at the time was not in a position to establish any relations with us. In a later letter he told me that he had also begun to work in the same direction, having procured a sum of money and a suitable locality in Penikese Island, where he would try to establish a school of marine biology. In the year 1881 Professor Whitman, now of Chicago University, came to Naples, on his return from Japan, where he had been professor at Tokio for two years, and asked for permission to work in the Zoölogical Station. Although there was no American Table for him I offered him hospitality, and he remained for six months. Half a year later came Miss Nunn, availing herself of the table of the University of Cambridge, also for six months. In 1883 Dr. Sharp, from Philadelphia, spent two months at the Bavarian Table. In the same year the first American Table was engaged by Williams College for one year, and this table was first occupied by Prof. E. B. Wilson, now at Columbia College, for six months, and was engaged later by Professor Clarke, of Williams College, but owing to sickness he postponed coming until the year 1884. In 1885 the table was subscribed for one year by the University of Pennsylvania, and was occupied first by Dr. Dolley and later by Dr. Patten. Dr. Patten was also received for six months as our guest.

"All my efforts to secure the coöperation of other American colleges proved unsuccessful, and again the American naturalists took advantage of the English and German Tables. Dr. Cobb, of Massachusetts, occupied the British Association Table for two months. Mr. Norman, of Indiana, occupied the Hamburg Table; Mr. Ward, from Troy, the table of the Grand Duchy of Baden, and Mr. Kaufman one of the Prussian Tables. This was in the spring of 1891, when Major Davis first visited Naples and became acquainted with the state of things. He immediately offered, in a most generous way, to engage a table for his countrymen, and asked me not to admit any more Americans to the European tables. His table was immediately occupied by Dr. Russell, a botanist, who worked here during four months; by Miss Platt, of Boston, for three months, and again in the second year by Professor E. B. Wilson, then of Bryn Mawr. Dr. Corning, also an American, but occupying the post of assistant in Prague University, came upon one of the Austrian Tables, and Dr. Bashford Dean, of Columbia, upon the Bavarian Table, while the Davis Table was occupied by others. In the year 1893 the Davis Table was occupied by Dr. Field, of Baltimore, and Dr. Parker, from Harvard College. In the meantime Dr. C. W. Stiles, of Washington, who had paid a short visit to the Zoölogical Station in 1891, led a movement for the establishment of more direct official relations between American institutions and the Zoölogical Station, and finally upon the unanimous recommendation of the Society of American Naturalists, the secretary of the Smithsonian Institution entered into a contract for

an American table for three years. Almost at the same time Professor Agassiz engaged a table for Harvard College for three years. Both of these tables are in demand by so many investigators that they still do not cover the needs of American students. In fact, there have always been more American occupants than tables, and I receive them willingly as guests. Dr. Fairchild, of Washington, Dr. Wheeler, of Chicago, and Professor Bumpus, of Brown University, occupied the Smithsonian Table in 1893–94, while Mr. Rice, of Washington, occupied the Harvard Table in 1894. In 1894–5 Dr. Murbach, of Berkeley, occupied the Smithsonian Table, while Dr. Child and Professor Ritter, of the University of California, occupied the Harvard Table. At the same time Professor Hargitt, of Syracuse University, and Professor Gardiner, of the University of Colorado, were received as guests. At the present time Professor Morgan, of Bryn Mawr, and Professor Leslie Osborn, of the University of Indiana, are occupying the Smithsonian Table, and Dr. Nutting and Professor Reighard are soon expected to arrive.

"These twenty-nine American naturalists have already profited by the Zoölogical Station, and many more would have come had arrangements been made earlier and on a larger scale. In comparison with European states, I may state that Germany rents eleven tables, Italy nine, Austria-Hungary three, England three, Russia three (which were discontinued this year, but are going to be continued). Spain has had three, which have been for a time discontinued, but will most likely be re-established. Holland, Belgium, Switzerland and Roumania have each one table. I entertain the hope that France and the Scandinavian kingdoms will subsequently secure tables. I am glad to say that the Zoölogical Station is quite capable of giving them all the full benefit of its complete arrangements."

This letter places before American zoölogists in the most direct and convincing manner the importance, not to say obligation, of remedying the past infringement upon the hospitality of the broad-minded director of the famous station. The Smithsonian table and the Harvard table should now be supplemented by a third, and it is to be hoped that some means will be found of adding $250 to the generous subscription of Mr. Dodge and securing this end.

HENRY F. OSBORN.

CORRESPONDENCE.

PITHECANTHROPUS ERECTUS.

MR. EDITOR: In SCIENCE of January 11, p. 47, Dr. D. G. Brinton reviews under the title 'The Missing Link Found at Last,' Dr. E. Dubois' Memoir on *Pithecanthropus erectus*. Dr. Brinton, while accepting the dental apparatus to be of the simian type, acknowledges that the skull is like the famous Neanderthal man, and that the femora are singularly human. Professor O. C. Marsh (Silliman's Journal, February, 1895, p. 144) calls *Pithecanthropus* an 'ape-man.' In another place he alludes to it as a 'large anthropoid ape.' A communication signed 'R. L.,' presumably Richard Lydekker, appeared in 'Nature,' January 24, 1895; the ground is taken that the femur of *Pithecanthropus* is 'actually human;' that the skull 'can belong to no wild anthropoid;' and that the molar may 'perfectly well be human.'

It thus appears that differences of opinion are already being entertained, respecting the validity of *Pithecanthropus*. I have ventured to make a contribution to the subject,

since I quite agree with 'R. L.' The single tooth preserved (see the accompanying cut)

is the third upper molar. It possesses two divergent roots. Contrary to what one expects, the smaller part of the crown forms the outside (buccal), and the larger the inside (palatal) surface. Du Bois thus describes the tooth on the assumption that the broader of the two roots represented two other confluent roots. If the broader half of the crown were outside (as it appears to be from the figure) the identification of the tubercles on the grinding surface would be easy. As it is, it is difficult, if not impossible, to name the cusps. The tooth must be classified as irregular and degenerate. I am in the habit of naming such teeth, crater-like, since all sides of the crown are uniformly higher than the centre, and the sides of the single valley are much fissured. We often meet with such teeth in man, but so far as I know they have not been seen in apes.

The tuberculation in the gorilla for the third molar is complete; the fourth cusp (hypocone), while rudimentary, is distinct. In the chimpanzee, according to Owen, the third molar is tritubercular, but in a specimen in the Academy of Natural Sciences of Philadelphia, it shows distinctly the rudiment of a hypocone. In the orang the third molar is distinctly quintitubercular, the fifth cusp being developed in the commissure between the mesocone and the hypocone.

The tooth of *Pithecanthropus* is larger than any human tooth with which I am familiar. The following table will place its measurements in harmony with ape and human teeth.

	Length.	Width.
Pithecanthropus,	11.3 mm.	15.3 mm.
Gorilla,	14.1 "	13.5 "
Orang,	12 "	13 "
Chimpanzee,	10 "	10 "
Native of Australia, (1)	10 "	13 "
" " " (2)	10 "	14 "
" " Sandwich Islands,	10 "	13.5 "

In Owen's Odontography the gibbon is seen to possess a molar of length 6 mm. and width 7.5 mm.; but even here the form of the tooth is quite unlike that of *Pithecanthropus*, being tritubercular with a rudimental hypocone. The tooth, unlike that of any anthropoid ape examined, is wider than long. The proportion of the width in comparison to the length is much the same as in the third molar of the human subject. The great size of the tooth and the possession of three roots, forming two diverging root-stems are distinguishing characters, but they are not simian. Some allowance must be made for the great variability in the shape of the third upper human molar.

Respecting the calvarium, I note in the view of the vertex a median elevation apparently over the interfrontal suture. This is often met with in the human skull, but so far as I know is never seen in the skull of the ape. The recession back of the external orbital process differs only in degree from that seen in man. The femur is indubitably human.

HARRISON ALLEN.

PHILADELPHIA, Feb. 14, 1895.

THE ELIHU THOMSON PRIZE.

THE EDITOR OF SCIENCE: Your transatlantic contemporary, *Nature*, has from its beginning enjoyed a large support among scientific men of the United States. It is so well conducted, and combines in so unusual a degree freshness and reliability, that it it is almost indispensable, and Americans continue to renew their subscriptions annually, in spite of the very general feeling and not infrequently expressed opinion that, on the whole, it is not now and never has been quite fair or just in its treatment of American science and scientific men.

An illustration of this is to be found in a recent number (January 31, 1895) which is so striking as to deserve attention. On page 324 will be found a note in reference to the recently announced award of the Elihu Thomson Prize (see this journal, page 190). It is a most ingeniously con-

structed account of the award made by the Paris Committee, the preparation of which must have cost the writer no small effort. So skilfully, however, are the words selected and the phrases arranged that, to one unfamiliar with the facts, the note appears to be a simple and straightforward statement that in declaring the award the Committee announced that it had found two memoirs of equal value and that it was decided to award a prize of 5000 francs to each, the collection of the additional money being the cause of the delay in the publication of the decision of the Committee. In the account of the affair in a recent number of SCIENCE it was pretty clearly stated that the memoir prepared by an American, Dr. Webster, of Clark University, had been adjudged by the Committee to be worthy of first place.

In order that every reader may be able to decide this matter for himself, the following quotations from the report of the Committee are submitted: Memoir 3 was that to be the work of Messrs. Oliver Lodge and R. T. Glazebrook, and No. 4 was that of Dr. Webster.

"Le n° 3 est consacré à la vérification de la formule donant la périod des décharges oscillantes d'un condensateur. C'est un travail considérable, accompagné de plusieurs photographies et dans lequel l'auteur a cherché, au moyen de calculs approfondis, à évaluer toutes les corrections inhérentes à l'emploi de sa méthode.

"La vérification n'est qu'approachée ; le principe de la méthode pourrait donner lieu à quelques critiques, le circuit de la décharge se fermant périodiquement par une étincelle qui introduit des perturbations impossibles à prévoir.

"Le mémoir n° 4 port sur le même sujet, étudié par une méthode nouvelle dans ses détails, qui a permis à l'auteur d'atteindre et de mesurer des périodes de quelques cent-millièmes de seconde. L'influence des principales causes d'erreur paraît très atténuée, bien qu'il reste encore quelques doutes sur l'influence de la capacité inhérente à la bobine de self-induction. La formule a été vérifiée a 1 pour 100 prés. Le temps a fait défaut à l'auteur pour compléter ses recherches en variant les conditions de ses expériences."

And then the following award from the 'procès-verbal' of the Commission :

"La Commission estime que le mémoire n° 4 est digne de recevoir le prix établi par le Professeur Elihu Thomson ; elle espére que ce témoignage encouragera l'auteur à continuer ses belle recherches.

"'Toutefois elle regrette de ne pas avoir à sa disposition deux prix d'égale valeur qu'elle serait heureuse d'attribuer aux mémoires n° 3 et n° 4.'"

A literal translation of the above, as a fair statement of its meaning is, perhaps, too much to look for in the columns of 'Nature,' but it is a pleasure to assure Messrs. Lodge and Glazebrook, whose names are 'household words' in every corner of this country, that their reputation is not such as to need bolstering by any oblique methods. M.

SCIENTIFIC LITERATURE.

Monographic Revision of the Pocket Gophers, Family Geomyidæ (exclusive of the Species of Thomomys). By DR. C. HART MERRIAM. North American Fauna, No. 8. Washington, Government Printing Office. 1895. 8vo, pp. 258, pll. 18, with 4 maps and 71 cuts in text.

In this memoir Dr. Merriam has produced an admirable piece of monographic work, setting a standard that may well be aimed at by other workers in the treatment of similar groups. The family Geomyidæ, or the Pocket Gophers, has hitherto been regarded as consisting of the two genera *Geomys* and *Thomomys*, only the first of which is here treated. It is a distinctively North American group, ranging from the

dry interior of British Columbia and the plains of the Saskatchewan to Costa Rica. The regions occupied respectively by the two groups, however, do not to any great extext overlap, *Thomomys* occupying in the United States the area west of the Great Plains, and the *Geomys* group the region between the Mississippi River and the eastern base of the Rocky Mountains, with outlying representatives in northern Florida and the contiguous portions of Alabama and Georgia. In Mexico *Thomomys* ranges over the peninsula of Lower California and a large portion of the interior of Mexico, which latter region it shares with numerous forms of the *Geomys* group, now broken up by Dr. Merriam into no less than nine genera. These collectively not only occupy a large part of central and southern Mexico, but extend as far southward as Costa Rica.

In respect to material Dr. Merriam has been especially fortunate, having availed himself of opportunities at his disposal as Chief of the Division of Ornithology and Mammalogy of the United States Department of Agriculture, to bring together material from a wide area and in an abundance scarcely dreamed of by any previous monographer of the group. Of the one thousand specimens thus rendered available for study, over two hundred are from Mexico and Central America, from which area the specimens previously handled by investigators could be counted on the fingers of the two hands. Hence not only has the known area inhabited by these animals been greatly extended, but the harvest of specimens has yielded novelties not previously suspected to exist.

Only about one-half of Dr. Merriam's excellent memoir is given to the systematic descriptions of the genera and species, the first hundred pages being devoted to the generalities of the subject—habits, function and structure of the cheek pouches, food, sexual and individual variation, geographical distribution, etc., about 15 pages—and to chapters on the morphology of the skull (30 pages) and the dental armature (36 pages). Nearly seventy of the text figures and six plates relate to the structure of the skull and teeth, this profusion of illustration greatly facilitating a clear comprehension of the points discussed in the text, and forming a most important feature of the work.

In coloration, size and in external details generally, the species of Geomyidæ are very much alike. There are, however, large forms and small forms, between which there is a wide difference in size, and also forms that are normally plumbeous instead of the usual shade of yellowish brown, but in general, even for the discrimination of species, resort must be made to structural details of the skull and teeth, which often afford characters of importance where external differences are nearly inappreciable. The range of variation in cranial and dental characters is so great, in these animals which look so much alike externally, that Dr. Merriam has felt justified in separating the old genus *Geomys* into nine groups which he thinks should rank as genera, 'several of which' he says, 'are of supergeneric value.' These genera are *Geomys*, *Pappogeomys*, *Orthogeomys*, *Cratogeomys*, *Platygeomys*, *Orthogeomys*, *Heterogeomys*, *Macrogeomys* and *Gygogeomys*. While these are apparently natural groups, doubtless taxonomers will differ as to whether all are entitled to full generic rank.

In 1857 Baird recognized seven species of *Geomys*, of which six retain place in Merriam's list. In 1877 Coues, in his monographic revision of the genus, admitted five. During the last two years others have been described, raising the number currently admitted in 1894 to sixteen. To this number Dr. Merriam here adds twenty-one, raising the total of species and sub-species to *thirty-seven!* Only the genera *Geomys*

and *Cratogeomys* are represented in the United States; the former, with seven species and five sub-species, scarcely extends across our southern border; the latter, with seven species and one sub-species, is mainly Mexican, one species, however, ranging northward over southeastern New Mexico and northwestern Texas. *Macrogeomys* is known only from Costa Rica; *Heterogeomys* and *Orthogeomys* occupy separate areas in southern Mexico and Guatemala; *Pappogeomys*, *Platygeomys* and *Zygogeomys* occur in central and western Mexico, the latter being known only from a very restricted area in the State of Michoacan.

The chapters on the Morphology of the Skull and the Dental Armature bring into strong relief many points in relation to changes of structure, due to age and growth, which have heretofore been only lightly touched upon, and especially the influence of the masseter muscle upon the general shape of the skull in adult life. The facts here presented may well be studied with care and profit by students of not only the mammals of to-day, but of the extinct forms as well. The skull is considered not only as a whole, but its individual bones are treated in detail, with cuts showing the skull sectionized, and young skulls in comparison with old ones of the same species. The memoir thus illustrates some of the best work and the tendencies of the 'new school' in recent mammalogy. In fact, no similar group of mammals has before been treated in such exhaustive detail, or from a morphological standpoint, or with such admirable profusion of illustration.

J. A. ALLEN.

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.

The Planet Earth. RICHARD A. GREGORY, 16 mo, pp. 108. Macmillan & Co., New York. Price 60 cents.

This little book is called 'An Astronomical Introduction to Geography.' In the preface the reader is promptly informed that in class books on Astronomy and Geography the subject of the earth considered as a planet is treated inadequately and unscientifically. The author expresses his hope that his treatment, which, by inference, is both adequate and scientific, may be the means of reviving the 'Observational Astronomy of pre-telescopic times.' Just why the telescope should be tabooed, or why it is less 'scientific' than strings with beads strung on them, does not clearly appear. It is quite evident, however, that the author wishes to restore what is sometimes called the 'historical' method of presentation and instruction, according to which the student is expected to traverse the path along which mankind has slowly toiled in order to reach conclusions which in the present state of our knowledge are often quickly attained by perfectly logical processes. There is, also, generally involved in this method, the erroneous assumption that a student can, in the short time available for his training in science and scientific methods, re-discover for himself all the great facts and principles which are the fruit of ages of intellectual activity, if only he has a few simple appliances at hand and is started in the right direction. This is a very large error, and it is not desirable to pursue it farther at this point. Admitting, therefore, and no one will venture to deny this, that much can be learned by a proper study of the apparent motions of the heavenly bodies, and that young people should be led to make such study before finishing or even beginning their study of the earth, as it is presented in the so-called unscientific treatment in Astronomy and Geography, it is yet extremely doubtful if the book now under consideration will be of real value to them.

The first chapter, which forms a considerable part of the whole, is devoted to 'the constellations.' The continued fixedness of

the North Star at one point in the sky is established by a quotation from Shakespeare, but there is an intimation later that the distinguished poet was possibly a little weak in his Astronomy. The author is very fond of bolstering up quite generally accepted scientific theories by poetic quotations, and even in the case of the Law of Gravitation, against which there can hardly be said to be any serious rebellion at the present time, he finds it desirable to repeat that bit of nonsense beginning,

"The very law that moulds a tear,"

for the existence of which not even poetic license furnishes excuse.

In the discussion of the size and mass of the earth, as elsewhere, great unevenness is shown. On one page is a diagram of a complicated piece of triangulation by the British Ordnance Survey, including the base-line on Salisbury Plain, and on that opposite is one explaining angular measure and terrestrial latitude by opening the legs of a pair of compasses. In the discussion of latitude there are many errors, and a beginner will be greatly helped by not reading it. There is a good deal about the Zodiac, with incidental references to 'mansions in the sky' and the emotions with which the first men witnessed the first Setting of the Sun, 'to whom he was dead,' together with a brief account of how their hopes were buoyed up and their fears calmed by the appearance of the 'Evening Star.' See wood cut on opposite page representing Venus shining upon a rural scene, including a village of at least twenty houses, a church with a tall spire tipped with a cross, and calming the fears of a farmer driving a yoke of oxen drawing a cart on which is probably a half ton of hay or grain or something of the sort. This is a marvellous development for a single day. At this point more poetry appears, and the rigorously scientific treatment is enhanced in value by numerous references to Lucifer, Apollo, etc., etc.

To illustrate the phases of Venus, which, by the way, hardly belong to pre-telescopic astronomy, the author shows a picture in which a lamp represents the sun, and a comely young woman with quite-up-to-date leg-of-mutton sleeves is represented as standing in four positions, in front of, behind, on the right and on the left of the luminary as viewed by the reader. Unfortunately it has been thought necessary to represent this young lady as looking squarely at the sun in all of the four positions, and thus what is intended to simplify the explanation of one phenomenon proves to be much more effective in establishing a very erroneous conclusion respecting another. And this is not the only happening of this kind in the barely one hundred pages of the book. To one who only 'skims' through it, it is reminiscent of the days of a quarter or half century ago, when 'Astronomy and the Use of the Globes' was a favorite subject in young ladies' seminaries. A more careful examination shows, however, that it is not so harmless as might at first appear, and although it unquestionably contains some good features it is quite safe to predict that the 'inadequate and unscientific' treatment of the subject found in good, modern text-books of Astronomy and Geography will continue, for the present, to receive the confidence of both instructors and students.

T. C. M.

Biological Lectures Delivered at the Marine Biological Laboratory of Wood's Holl. 8vo, 242 pp. Boston, Ginn & Co. 1894.

In no way, short of an actual sojourn at the Wood's Holl Laboratory, is it possible to secure a better idea of the scope and character of the opportunities afforded by this institution than by the perusal of this series of selected lectures. Wood's Holl is at once the 'finishing school' of the American biological student, and the rallying point

for trained investigators. Its biological laboratory affords advantages which are each year more widely appreciated, and one has but to glance over the titles of the papers listed in the appendix to the volume under consideration, to be impressed with the scientific vigor which characterizes both its staff and pupils.

The ten lectures for 1894 bear the following titles: I. 'The Mosaic Theory of Development,' by E. B. Wilson. II. 'The Fertilization of the Ovum,' by E. G. Conklin. III. 'On Some Facts and Principles of Physiological Morphology,' by Jacques Loeb. IV. 'Dynamics of Evolution,' by J. A. Ryder. V. 'On the Nature of Cell-Organization,' by S. Watasé. VI. 'The Inadequacy of the Cell-Theory of Development,' by C. O. Whitman. VII. 'Bdellostoma Dombeyi Lac,' by Howard Ayres. VIII. 'The Influence of External Conditions on Plant Life,' by W. P. Wilson. IX. 'Irrito Contractility in Plants,' by J. Miurhead McFarlane. X. 'The Marine Biological Stations of Europe,' by Bashford Dean.

Of these papers more than one-half are concerned in a presentation of the results of modern research into the activities of the living cell, and it would be difficult to direct a student to any one volume from which he might gain a clearer idea, or find a more satisfactory discussion, of the present condition of theory and established fact concerning the cell state. Prof. E. B. Wilson strikes the key-note of the motive which runs through the book when he calls attention, on the first page, to the remarkable change of front which has taken place during recent years respecting the germ-layer theory—namely: (*a*) the growing recognition of the inadequacy of a theory of development which practically ignores the pregastrular stages of the ovum; and (*b*) the tendency to resume the attempts of Brücke and others to formulate a pre-organization theory which should account for the evident organization of the cell, by the postulation of primary elements, or bearers of cell qualities; the 'physiological units' of Herbert Spencer, the 'gemmules' of Darwin, the 'Micellæ' of Nägeli, the 'plastidules' of Elsberg and Haeckel, the 'inotagmata' of Th. Engelmann, the 'pangenes' of De Vries, the 'plasomes' of Wiesner, the 'idioblasts' of Hertwig, the 'biophores' of Weismann, and finally the 'idiosomes' of Whitman, in which may be found 'the secret of organization, growth and development.'

The tendency in modern biology is, in other words, to rob the cell of its leadership in the phenomena of organization, and to regard it as but a 'biotome,' life epoch, or form-phase; correlated with a series of visible cell-aggregates (organs and tissues) on the one hand, and to another series of invisible aggregates of diminishing complexity, which terminate finally in protoplasmic molecules variously designated, as indicated above. These living molecules are pointed out as the foundation of organization, and the protoplasmic molecule, the 'Specifische Bildungstoffe' of Sachs, as the 'essential archetectonic element;' furnishing a common basis for every grade of organization, but 'subject to a regenerative and formative power existing as one and the same thing throughout the organic world' (Whitman). The prevailing thought of the book seems to be expressed by Ryder in the conviction "that experimental investigation in embryology will make no solid progress until all such conceptions as gemmules, biophores and idiosomes are abandoned," and in the dictum of Loeb that "all life phenomena are determined by chemical processes." We are asked to concur in the admission that "the phenomena of life are ultimately physical in their nature and are to be treated in detail as physical problems."

We may derive from these essays a notion of the drift of biological thought in the

immediate future which will undoubtedly throw much light on the behavior of protoplasm through the investigation of its molecular relations, its surface tensions, vortex movements, chemotropism, chemotaxis, polarity, etc.; but many will doubt whether this treatment of life phenomena 'as purely physical and chemical problems' will do away with the conception of some anagenetic or organic growth force, some bathmic energy, such as is assumed by Cope in his consideration of the 'Origin of Structural Variations.'

That physical and chemical influences tend to *locate* growth force is becoming more and more evident, from such studies as we have presented to us in these lectures, and in recent researches like those of Bütschli on 'Protoplasm and Microscopic Forms,' Loeb on 'Physiological Morphology,' and Vaughan, Halliburton and others on the 'Nucleins.' There is no reason to doubt that surface tensions may lie behind all protoplasmic movements; that polarity, gravity, geotropism, heliotropism or thermotropism may determine the direction of growth, and that osmosis, metabolism, or the presence of nuclein may explain the ability of cells to utilize the pabulum within their reach, but the explanation seems, somehow, to be inadequate.

Notwithstanding the brilliant achievements of experimental science, the oracular dicta of the modern priests of monism or materialistic empiricism carry little conviction. One turns away with a sense of dissatisfaction and a lingering doubt whether mechanism and organism are after all identical. Haeckelismus has by no means proven itself infallible, and the reading of these lectures will be much more interesting to many, from the fact that here and there are to be found wide differences of opinion on fundamental questions; while along with the assurance that certain present statements must be regarded as axiomatic; long established theories are shown to be inadequate; long discarded theories are resuscitated and presented, rehabilitated and disguised. The moneron no longer stands in its integrity as the material basis and starting point of life. The student of the cell finds himself confronted with a microcosm, not with an ultimate unit of life, and is puzzled to know whether he may account for this complex organism by differentiation from some homogeneous *Anlage* or rudiment, or whether nucleus and cytoplasm represent dissimilar organisms, which 'by mutual adaptation have given rise to a third organism, in which each of them serves as organ to the whole.'

As the facts of particulate inheritance have led to a rehabilitation of the old theory of incasement, preformation or pangenesis, it seems not improbable that having traced 'the secret of organization, growth and development' beyond the cell to certain 'ultimate elements of living matter,' 'idiosomes,' or protoplasmic molecules, and bearing in mind that these living molecules must have a complex atomic organization, inasmuch as 'function presupposes structure,' we find ourselves forced to ask what determines the upbuilding of atomic aggregates combining the physical and chemical complexity essential to the phenomena of growth and evolution. In reply we are presented with a prepotent 'plastic power' (Schwann); a 'regenerative and formative power, one and the same thing throughout the organic world' (Whitman); this is probably the 'formative impulse' of Schleiden. Cope (*loc. cit.*) refers us to 'a special form of energy known as growth energy or Bathmismel.' In what way does this 'plastic power,' 'formative impulse' and 'growth energy' differ from the 'vital force' of Planck, Schelling, Schopenhauer and other philosophers? The physiological morphologist has carried us back to living protoplasmic molecules varying greatly, and

which he finds himself able to direct somewhat in their future combinations, as the chemist handles radicles and proximate principles; but President Schurman has long since pointed out that there is a 'fundamental contrast between the initial variations and the subsequent means of their preservation'; for example, between modifying organisms and originating idiosomes and 'that where science stops, philosophy begins.'

It is to this lothfulness to directly admit that Czolbe was right in saying: "The power of organisms cannot be explained by the planless and formless physical and chemical activities;" that Schurman refers in saying: "This jugglery with causality, as though in time everything could be got out of almost nothing, is the besetting sin of Darwinists." CHARLES S. DOLLEY.

PHILADELPHIA.

Aero-therapeutics or the Treatment of Lung Diseases by Climate. By CHARLES THEODORE WILLIAMS. London and New York, Macmillan & Co. 1894. 8°, pp. 187.

This is a good book by a competent authority, being the Lumleian lectures for 1893, by Dr. Williams, who is the senior physician to the hospital for consumptives at Brompton, and the late President of the Royal Meteorological Society. It includes a discussion of those factors and elements of climate which bear directly upon human health, and is especially full upon the subject of atmospheric pressure and its variations, and on the effects of high altitudes upon cases of consumption.

The effects of such altitudes as are usually resorted to for curative purposes depend in part upon the rarefaction and increased diathermancy of the atmosphere, and in part upon the change in habits, exercise and food which is made when becoming a resident of such a resort. One of the most definite effects produced by diminished atmospheric pressure upon the healthy animal organism is an increase in the number of the red corpuscles of the blood, which has been shown by Viault and Eggar to occur in man to the amount of 16 per cent. in the course of three or four weeks. Mountain races usually have large chests, comparatively great activity of the respiratory organs, and great power of endurance for walking. They are usually remarkably free from scrofula and consumption, which is probably due to absence of overcrowding and to their comparatively great amount of out-door life, which greatly lessen the chances of their becoming infected with the tubercle bacillus. The sending of consumptives to high altitudes is a method of treatment which has come into vogue within the last thirty years, Davos and St. Moritz being the first of this class of health resorts to attract special attention. Dr. Williams concludes that this mode of treatment is most effective in recent cases of consumption, that at least six months', and in many cases two years', stay is desirable, and that it produces great improvement in about 75 per cent. of the cases, and a cure in about 40 per cent. One chapter of the book is devoted to the high altitudes of Colorado and their climates, and is based on the author's personal observations. The greater part of the surface of this State is over 5000 feet above the sea level, and some of the most beautiful parks are above 7000 feet in altitude, the atmosphere is dry and clear, and there is sunshine the year round, all of which are important factors in the treatment of consumption. Physicians will find Dr. Williams' comments upon the importance of these great mountain plateaus and parks, as a location for consumptive patients in the first stages of their disease, to be interesting and valuable.

PHYSICS.

On the Voluntary Formation of Hollow Bubbles, Foam and Myelin Forms by the Alkaline

Oleates, together with Related Phenomena, Especially those of Protoplasm. G. QUINCKE. Wiedemann, Ann. 1894. Vol. 53, p. 593.

This article is a continuation of Prof. Quincke's investigation published in 1888 (Weid., Ann., Vol. 35, 1888, p. 562, et seg), and a reply to the criticisms which his article provoked. It gives the results of elaborate investigations upon the phenomena observable upon mixing various soaps, oils and water, and traces them to surface tension and allied forces. Some very interesting suggestions are given upon the similarity of some of the resulting appearances, with the arrangement of the heavenly bodies in space, and a strong likeness is shown between some of these peculiar bubbles with very thin, solid walls formed in such mixtures, and some of the formations in plant cells. The observations also go far toward explaining the motions sometimes observed in cells, which would seem to be due to the same forces as produce those peculiar motions of a drop of oil upon water.

On the Comparison of High Range Mercury Thermometers of Jena Glass 59III, with the Air Thermometer at temperatures between 300° and 500° C. By ALFONS MAHLKE. (Wied. Ann. 1894. Vol. 53, p. 965.)

Contains a very careful determination of the apparent co-efficient of expansion of mercury in Jena glass 59III, and demonstrates the availability of mercury thermometers made of this glass for the measurement of temperatures up to 500° C. (900° Th). WILLIAM HALLOCK.

On the Units of Light and Radiation. By A. MACFARLANE, D. Sc., LL.D. A paper read before the American Institute of Electrical Engineers, 16th January, 1895. (Abstract.)

The author shows that the difficulty experienced in defining and denoting the different ideas commonly expressed by the word 'candle' is due to the want of a name for the unit of solid angle; and suggests the word *steradian*, which has already been used for that purpose.

He considers the different physical ideas in the general subject of radiation, and shows the appropriate expression for the unit of each. With this system of radiation units he compares the system of units of light recently proposed by M. Blondel, and shows that the light system ought to be parallel to, not identical with, the radiant energy system. Finally he discusses M. Hospitalier's proposed symbols for light quantities.

GEOLOGY.

Report on the Bevier Sheet, by C. H. Gordon and others. ARTHUR WINSLOW, State Geologist, Mo. Geol. Surv. 1894.

This is the second of a series of detailed reports on areal geology in Missouri. The main feature is a carefully prepared and well executed topographic and geologic map, which includes portions of Macon, Randolph and Chariton counties, an area of about 250 square miles. This map is on a scale of $\frac{1}{62250}$ and the topography is shown by contours of 20 feet interval. The topographic base was executed by Messrs. C. H. Gordon, C. F. Marbut and M. C. Shelton. On the map are shown the horizon lines of the coal beds and the distribution of the geological formations, as well as the location of coal pits, drifts and drill holes. It is accompanied by a sheet of columnar and cross-sections, which give details of the geology. In the accompanying text, Mr. Gordon describes the physiography, including the topography, drainage, soil, forestry, etc., and the stratigraphic and economic geology. The Quaternary geology is reported on by Prof. J. E. Todd, and the distribution of the clays and shales by Mr. H. A. Wheeler, E. M., who were employed as specialists and whose reports on these subjects for the whole State are in process of preparation. J. D. R.

NOTES AND NEWS.

A. A. A. S. TABLE AT WOODS HOLL LABORATORY.

IN joint session of Sections F and G, the following resolutions of the Committee of the A. A. A. S., on a table at the Marine Biological Laboratory at Woods Holl, Mass., were offered by Dr. S. H. Gage for adoption by the Sections:

The Sections of Zoölogy and Botany (F and G) request that the Association continue its subscription of $100 for an investigator's table at the Marine Biological Laboratory at Woods Holl, Mass.

The two Sections in joint Session also make the following suggestions for the award and government of the table subscribed for by the Association:

1. That the table shall be known as the A. A. A. S. table.

2. That the award of this table shall be entrusted to a committee of five, consisting of the vice-president and secretary-elect of each Section (F and G), and of the director of the Marine Biological Laboratory (at present C. O. Whitman).

3. Any fellow or member of the A. A. A. S. shall be eligible for appointment to the table. (An applicant for membership in the Association will be considered as a member, and therefore eligible.)

4. Applications for the table are to be made to the permanent secretary, who shall forward them to the senior vice-president of Sections F and G, seniority being determined as in § 11 of the Constitution, *i. e.*, according to continuous membership.

5. That the holders of the Association's table are expected to give proper credit for the use of the table in all published results of investigations carried on at the table.

[The grant for the table was made by Council.]

GENERAL.

PROFESSOR T. H. MORGAN and Professor Herbert Osborn have been awarded the Smithsonian Table at the Naples Zoölogical Station for periods lasting until October 8, 1895. After that date the table will be vacant and applications for it may be addressed to Professor Langley, Secretary of the Smithsonian Institution.

LORD ACTON succeeds the late Professor Seeley in the professorship of modern history at the University of Cambridge.

PROFESSOR W. W. CLENDENIN, of the State University of Louisiana, has been appointed geologist in charge of a survey of the State.

DR. LOMBARD, known for his writings on climatology, died at Geneva on January 22, in his ninety-second year.

ACCORDING to *The American Naturalist*, Mr. R. T. Hill, of the U. S. Geological Survey, is in Panama, and Dr. H. C. Mercer, of the University of Pennsylvania, is in Yucatan.

THE New York Assembly has passed a bill appropriating $1,175,000 for the purchase of a new site, and the erection of buildings for the College of the City of New York.

THE American Museum of Natural History has applied to the Legislature for $500,000, for an addition wing, which would complete the southern front of the building.

THE Arizona Legislative Assembly has presented a memorial to Congress, requesting that the district in Apache county covered with trunks of petrified trees be withdrawn from entry with a view to preventing destruction and injury until the district has been made a public park.

THERE have been so many requests for copies of Prof. Charles S. Minot's article in the *Popular Science Monthly* for July, 1893, entitled 'The Structural Plan of the Human Brain,' that the article has been reprinted and copies may now be obtained at twenty cents each, from Mr. Charles B. Wormelle, 6 Menlo Street, Brighton District, Boston, Mass.

SOCIETIES AND ACADEMIES.

MICHIGAN SCIENCES AND ACADEMIES.

AFTER some discussion and correspondence, a preliminary meeting was called at the State University in Ann Arbor, last June, and an organization effected. The following officers were elected to serve for the first meeting which was held in connection with that of the State Teachers' Association, December 26–27, in the State Capitol at Lansing:

President—W. J. Beal.

Vice-President—J. B. Steere.

Secretary and Treasurer—F. C. Newcombe.

Additional Members of the Executive Committee—W. B. Barrows, I. C. Russell.

At the close of the meeting very nearly an even hundred members were enrolled.

A very complete constitution and by-laws were adopted. One of the main features of the Society is to proceed systematically with a State biological survey. The State will be asked to publish the transactions, and to furnish some aid toward conducting field work.

Three vice-presidents were elected who are to act as chairmen of committees on Botany, Zoölogy and Sanitary Science. Doubtless other vice-presidents for other work may be elected at the next annual meeting.

An informal field meeting will be held in May or June.

Those in attendance were much pleased with the first program as carried out in Lansing, and are showing much enthusiam regarding future work. The objects of the Society, as now stated in the constitution, are the investigations in Agriculture, Botany, Zoölogy, Sanitary Science, Archæology and kindred subjects, but may include other departments when workers are ready to enter the field.

The present officers are:

President—Bryant Walker.

Vice-President—Frederick C. Newcombe.

Vice-President—Jacob E. Reighard.

Vice-President—Henry B. Baker.

Secretary—G. C. Davis.

Treasurer—E. A. Strong.

The program was as follows:

WEDNESDAY, 1:30 P. M.

1. *Call to order and introductory remarks by the President.*
2. *Report of the Executive Committee.*
3. *Determination of the hour for Election of Officers, and for Other Business.*

PRESENTATION OF PAPERS.

1. *The Mammals of Michigan:* DR. J. B. STEERE.
2. *The Birds of Michigan:* PROF. D. C. WORCESTER.
3. *Additions to the Flora of Michigan:* MR. C. F. WHEELER.
4. *The Cryptogamic Flora of Michigan:* MR. L. N. JOHNSON.
5. *Work of the Michigan Fish Commission:* DR. C. A. KOFOID and PROF. H. B. WARD.
6. *The Michigan Lepidoptera:* DR. R. H. WOLCOTT.

WEDNESDAY. 7:30 P. M.

7. *Our Society and a State Survey:* PROF. W. J. BEAL.
8. *Practical Benefits of Bacteriology:* PROF. F. G. NOVY.
9. *Simian Characters of the Human Skeleton:* PROF. W. H. SHERZER.
10. *Date and Development of Michigan Archæology:* MR. HARLAN I. SMITH.
11. *Some Notes on the Michigan Coat of Arms:* PROF. W. J. BEAL.
12. *Teaching Botany in Winter:* PROF. W. J. BEAL.

THURSDAY, 9:00 A. M.

13. *Flora of Michigan Lakes:* PROF. CHAS. A. DAVIS.
14. *Michigan Lepidoptera:* DR. R. H. WOLCOTT.
15. *Review of our Present Knowledge of the*

Molluscan Fauna of Michigan: MR. BRYANT WALKER.

16. *Distoma Patalosum; A Parasite of the Crayfish:* MR. C. H. LANDER.
17. *Bacteria and the Dairy:* PROF. C. D. SMITH.
18. *Tendencies in Michigan Horticulture:* MR. A. A. CROZIER.
19. *Futile Experiments for the Improvement of Agriculture:* DR. MANLY MILES.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

PROFESSOR DANIEL G. BRINTON is giving a course of six lectures, entitled *A Survey of the Science of Man*, on Mondays, January 28, February 4, 11, 18, 25, and March 4, 1895, in the Lecture Hall of the Academy.

The lectures are:

1. *The Physical Faculties of Man.*
2. *The Mental Faculties of Man.*
3. *The Social Faculties of Man*
4. *The Artistic Faculties of Man*
5. *The Religious Faculties of Man.*
6. *The Progress of the Race.*

GEOLOGICAL SOCIETY OF WASHINGTON.

FEB. 13.

Discussion of Field Methods: (1) How do you determine the Thickness of Strata? Symposium opened by MR. G. K. GILBERT. General discussion is invited.

Rapid Section Work in Horizontal Rocks: MR. M. R. CAMPBELL.

Newly Discovered Dyke near Syracuse, N. Y.: MESSRS. N. H. DARTON AND J. F. KEMP.

WHITMAN CROSS, *Secretary.*

PHILOSOPHICAL SOCIETY OF WASHINGTON.

FEB. 16.

Biographical Sketch of James Clarke Welling: MR. J. HOWARD GORE.

Biographical Sketch of Robert Stanton Avery: MR. L. D. SHIDY.

Biographical Sketch of Garrick Mallery: MR. ROBERT FLETCHER.

The Central American Rainfall: MR. MARK W. HARRINGTON.

WILLIAM C. WINLOCK, *Secretary.*

FORTNIGHTLY SCIENTIFIC CLUB IN THE UNIVERSITY OF MINNESOTA.

Jan. 19, 1895.

The Vivisection of Plants: MR. D. T. MACDOUGAL.

Is Man Woman's Equal? The Zoölogist's answer and some of its consequences: PROFESSOR H. F. NACHTRIEB.

Feb. 2, 1895.

The Departure of the Ice Sheet from Lake Superior and the more Eastern Laurentian Lakes: MR. WARREN UPHAM.

Some Things People Ought to Know About Micro-Organisms: DR. CHAS. N. HEWETT.

Feb. 16, 1895.

The Detection of Star Motions in the Line of Sight: PROFESSOR J. F. DOWNEY.

The Constitution of Matter: DR. G. B. FRANKFORTER.

SCIENTIFIC JOURNALS.

THE AMERICAN NATURALIST, FEB.

The Philosophy of Flower Seasons, and the Phænological Relations of the Entomophilous Flora and the Anthophilous Insect Fauna: (Illustrated.) CHARLES ROBERTSON.

Insanity in Royal Families; A Study in Heredity: ALICE BODINGTON.

The Significance of Anomalies: THOMAS DWIGHT, M. D., LL. D.

Editor's Table; Recent Literature; Recent Books and Pamphlets.

General Notes; Geography and Travels; Mineralogy; Petrography; Geology; Botany; Zoölogy; Entomology; Embryology; Archæology and Ethnoloyy; Microscopy: On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and other very small Objects for the Microtome. (Illustrated.)

Proceedings of Scientific Societies; Scientific News.

THE JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, FEB.

A Modified Arrangement of the Elements Under the Natural Law: F. P. VENABLE.

The Determination of Potash in Kainite: RUDOLPH DE ROODE.

The Oxidation of Organic Matter and the Decomposition of Ammonium Salts by Aqua Regia, in Lieu of Ignition, in the Determination of Potash in Fertilizers: RUDOLPH DE ROODE.

On Certain Phenomena Observed in the Precipitation of Antimony from Solutions of Potassium Antimonyl Tartrate: J. H. LONG.

An Examination of the Atmosphere of a Large Manufacturing City: CHARLES F. MABERY.

A New Form of Water-Oven and Still: LEWIS WILLIAM HOFFMANN and ROBERT W. HOCHSTETTER.

The Determination of Nickel in Nickel-Steel: E. D. CAMPBELL and W. H. ANDREWS.

The Volumetric Determination of Phosphorus in Steel and Cast Iron: W. A. NOYES and J. S. ROYSE.

The Contribution of Chemistry to the Methods of Preventing and Extinguishing Conflagration: THOMAS H. NORTON.

The Action of Organic and Mineral Acids Upon Soils: HARRY SNYDER.

New Books.

THE JOURNAL OF GEOLOGY, JAN.–FEB.

The Basic Massive Rocks of the Lake Superior Region. IV.: W. S. BAYLEY.

A Petrographical Sketch of Ægina and Methana. Part II.: HENRY S. WASHINGTON.

Lake Basins Created by Wind Erosion: G. K. GILBERT.

On Clinton Conglomerates and Wave Marks in Ohio and Kentucky: AUG. F. FOERSTE.

Glacial Studies in Greenland. III.: T. C. CHAMBERLIN.

Studies for Students:

Agencies which Transport Materials on the Earth's Surface: ROLLIN D. SALISBURY.

Editorials; Publications; Notes.

THE AMERICAN GEOLOGIST, FEB.

George Huntington Williams: JOHN M. CLARK. (Portrait.)

The Geological History of Missouri: ARTHUR WINSLOW.

A New Cretaceous Genus of Clypeastridæ: F. W. CRAIGIN.

Further Observations on the Ventral Structure of Triarthrus: C. E. BEECHER.

The Second Lake Algonquin: F. B. TAYLOR.

Editorial Comment.

Review of Recent Geological Literature.

Recent Publications.

Correspondence.

Personal and Scientific News.

THE BOTANICAL GAZETTE, FEB.

New or noteworthy Compositæ from Guatemala: JOHN M. COULTER.

A preliminary paper on Costaria, with description of a new species: DE ALTON SAUNDERS.

Notes on our Hepaticæ. III: LUCIEN M. UNDERWOOD.

The flora of Mt. Mansfield: W. W. EGGLESTON.

Briefer Articles.

Editorial; Current Literature; Open Letters; Notes and News.

NEW BOOKS.

Missouri Botanical Garden. Fifth Annual Report. St. Louis, Mo., Board of Trustees. 1894. Pp. 166.

The Great Ice Age. JAMES GEIKIE. New York, D. Appleton & Co. 1895. 3d Edition. Pp. xxviii+850. $7.50.

The Pygmies. A. DE QUATREXAGES. Translated by FREDERICK STARR. New York, D. Appleton & Co. 1895. Pp. xiv + 255. $1.75.

Annals of the Astronomical Observatory of Harvard College. Vol. XXXII., Part I. Investigations in Astronomical Photography. WILLIAM H. PICKERING. Cambridge, Mass., the Observatory. 1895. Pp. 115.